

Coolidge (a)

ON CAUTERIZATION BY GALVANISM.

(Read before the Boston Society for Medical Observation, November 5th, 1855, by Dr. ALGERNON COOLIDGE, and communicated for the Boston Medical and Surgical Journal.)

WITHIN the last twenty years a new method of applying electricity to medical purposes has been tried, and promises to become of greater practical utility than any other. This is the method of employing a wire, heated by galvanism to a red or white heat, instead of the knife, for some operations, and always instead of the old means of applying the actual cautery.

The first mention we have been able to find of this cauterization by galvanism, is in a passage of Becquerel's "Treatise on Electricity."* He says, "Dr. Fabré Palaprat has found in electricity a very simple way of applying instantaneously a moxa to the deepest seated parts of the body, without producing any appreciable lesion except at the point where it is applied. For this purpose a platinum needle is introduced into the affected part, and is put in communication with one of the poles of a voltaic pile, composed of elements with large surfaces, capable of producing powerful thermo-electrical effects; while the other pole, by means of a metallic plate, is in contact with a neighboring part of the body. The needle immediately becomes incandescent and burns the adjacent tissues, producing a strong pain but of short duration. Some days after, inflammation similar to that produced by a moxa sets in, and is followed by a scar which separates in the form of a quill." There is some mistake in this statement of Becquerel. The means he gives, as used by Fabré Palaprat, cannot produce the desired effect.

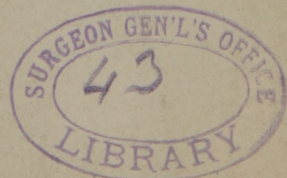
We must date, therefore, the first practical use of cautery by galvanism no further back than 1843.

Heider, in Vienna, acting upon a suggestion made to him two years previously, by Prof. Steinheil, of Munich, employed the galvanic cautery for the destruction of the dental pulp.

In 1844, fourteen months after the experiments of Heider, Louyet, in the *Archives de la Médecine Belge*, recommends the same method for the same purpose. He suggests combining the killing of the nerve and the filling of the tooth, by means of a melted globule of metal dropped into it.

In 1848 Gustavus Crusell, a Russian, published a communication on cautery by galvanism. He seems to have been the first to suspect what might be done by this method. He recommends it

* *Traité de l'Electricité*. Paris. 1836. V. 4, p. 306.



in anchyloblepharon and symblepharon, also for the extirpation of tumors. He made use of wire and of platinum foil for cutting, and of the latter for cauterizing a surface. In 1846, two years previously, a paper of his on "Galvanic Cautery" had been read before the Academy of St. Petersburg. In 1847 he operated upon a vascular tumor covering a great part of the forehead and region of the eye. He also opened the meatus urinarius, which in consequence of a chancre had become nearly closed. The first operation was performed by moving "to and fro" a platinum wire connected with a battery, and heated in the middle to a white heat, sawing the tumor off, as it were.

Sedillot, in his treatise on operative surgery (1853), refers to the publication in 1849, of the perfect cure of an erectile tumor by the use of the galvanic cautery, and says that MM. Nélaton and Maisonneuve have also employed it.

In 1851 John Marshall, of London, published an article "On the Employment of the Heat of Electricity in Practical Surgery," in the *Medico-Chirurgical Transactions*. He refers there to a case which is reported in the *Lancet* of May of the same year. A young man, 20 years of age, of a strumous habit of body, had a fistulous opening in the right cheek from a succession of abscesses. He had been under a variety of treatment for several months, without success. A fine platinum wire was passed through the fistula, so that its ends could be connected with a battery. The electric current was kept up for nine seconds. But little pain was felt. Sloughs appeared on both orifices of the fistula; that on the inner surface came away on the fifth day, that on the outer one on the sixth. The inner opening was closed on the eighth day, the outer on the eleventh. A small sinus was discovered some days afterwards on the inner surface of the cheek, and was cured within a fortnight by a repetition of the operation. The author mentions having used it with equal success in rectal fistula, and in external and internal hemorrhoids. He anticipates that in some cases this way of operating will be found advantageous as compared with the knife, scissors or ligature.

The *Lancet* of the same year contains the experiments of MM. Harding and Waite, both dentists. Harding owes his attempts to the perusal of Mr. Marshall's case.

In the *Gazette des Hôpitaux*, 1852, Mr. Nélaton mentions having used this cautery in different cases, with perfect success.

Mr. A. Amussat (in the *Comptes rendues de l'Académie des Sciences* for July, 1853) has used this method of cauterization in ulcers of the neck of the uterus, the extirpation of tumors, &c.

Ellis (*Lancet*, 1853) cauterizes likewise the neck of the uterus; he recommends it in prolapsus of the uterus, and of the vagina.

By far the most important work on galvanic cautery that has yet appeared, is the one of Prof. Middeldorpf, of Breslau in Prussia.* If

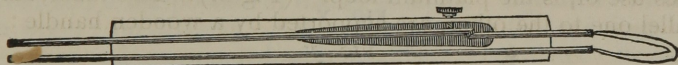
* Die Galvanocaustik, ein Beitrag zur Operativen Medicin. Von Dr. A. T. Middeldorpf. Breslau. 1854.

not the first to have used it, it is to him we are indebted for our present advance in it. He has certainly made this way of operating easy and practical. It was the perusal of Harding's method of destroying the dental pulp, that first caused him to devote his attention to the subject. The battery he prefers is a large Grove's battery, composed of four cells. The zinc cylinders are six inches long and four broad, each having about seventy-eight square inches of surface; the interior surface being alone reckoned. The positive element is composed of three pieces of platinum foil, each of which being nearly four inches long and three in breadth, the surface presented by it is over sixty square inches; so that the battery can be said to present two hundred and fifty square inches of surface of platinum, and two hundred and ten of surface of zinc. By a very ingenious arrangement of the rods connecting the several elements, he can have a strong or weaker current at pleasure.

The instruments Professor Middeldorpf uses are simple in construction and very easy to handle.

The first (the knife) is composed of two metallic tubes or rods running parallel through a wooden handle, and connected at one extremity by a platinum wire, of different shape for different operations, while the other extremities connect with the poles of a battery. One of the rods being divided obliquely within the handle, the circuit is broken. (Fig. 1.) By pressure on a button connect-

FIG. 1.



ed with one end of the divided rod, the ends are brought in contact and the circuit closed. The wire becomes immediately heated to a red or white heat, according to its size, and divides the tissues as easily as a knife. The wire is always of platinum, this metal requiring a very strong heat to melt it.

By means of this instrument, fissures and cavities can be burnt, abscesses opened, tumors removed, fistulas laid open, &c. The only difficulty consists in heating the wire to the appropriate temperature. If too hot, it acts too easily, and does not prevent hemorrhage; if not hot enough, it adheres to the tissues and causes, likewise, hemorrhage on being detached. Pain during the operation is generally pretty severe; after it, comparatively very slight.

Heider's instrument was on this plan; also Harding and Waite's. The latter used a lever instead of a button. Professor Middeldorpf now prefers a wedge, capable of being pushed forward to close the circuit, and backwards to break it; in this manner the continual pressure on the button is dispensed with.

The principle of the second instrument is the same as that of one just described. The difference consists in having a piece of platinum foil bent like an arch instead of the wire. This is useful for

burning large surfaces, as in the vagina, rectum or pharynx (where the heated metal serves as a lamp to work by).

Ellis (Lancet, 1851) invented a very practical instrument for cauterizing the neck of the uterus. At the end of the rods is a small porcelain crucible, heated by the wire that winds around it. (Fig. 2.)

FIG. II.

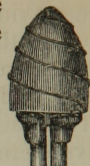
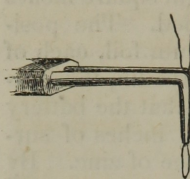
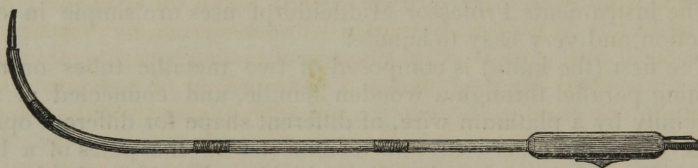


FIG. III.



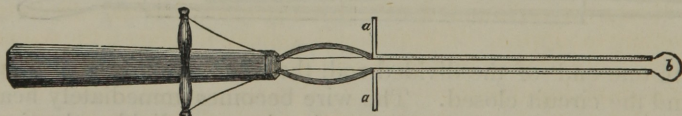
The instrument for cauterizing the lachrymal sac is bent at a right angle, and the wire is movable. (Fig. 3.) For operating upon strictures the instrument is either straight or has the curve of the male catheter (Fig. 4.), and can be enclosed in an elastic bougie to prevent any danger of burning the mucous membrane of the urethra.

FIG. IV.



The principal instrument, however, that Professor Middeldorpf makes use of, is the platinum loop. (Fig 5.) Two tubes, running parallel one to the other, are supported by a wooden handle; their

FIG. V.



ends (*a a*) connecting with the battery, are bent. They enclose a wire forming a loop (*b*) at the other extremities, and issuing from the tubes through an opening at the point of curvature. The loop is capable of being tightened to any desirable extent by drawing the free ends of the wire. For greater solidity the tubes are separated by a piece of ivory or other non-conducting substance, to which they are attached; and the wire can be wound round an axle, made for that purpose, by which way an uniform tightening of the loop can be obtained.

He performed his first operation on the 30th of March, 1853; the removal of a fibrous polypus in the posterior nares. No hemorrhage occurred. The following May he removed a laryngeal polypus, and has since then performed over sixty different operations, among which can be mentioned the cauterization of fistulæ, the destruction of a large erectile tumor, the perforation of a callous stricture of the urethra, and the removal of uterine and nasal polypi. A summary of the principal cases will not be without interest.

I.—*Neuralgia*. An old woman, 75 years of age, was suffering from neuralgia, having its starting point in one of five or six hemorrhoids situated around the anus; the pain, especially during defecation, was intense, and had caused the patient great suffering for months. In the operation the hemorrhoid was first compressed by the heated wire, which was afterwards carried around its base. Some drops of blood appeared; the pain was slight and of short duration. Opium was given to prevent a stool. The next day the neuralgic pain had disappeared, and the wound smarted but little. After five days the opium was discontinued. The first stool, produced by an injection, was very painful. After sixteen days the patient was discharged well. The hemorrhoid had disappeared, and the neuralgia never returned.

II.—*Fistula*. A workman, 44 years old, was admitted into the hospital suffering from a fistula near the right trochanter. Its direction was from behind forward; its length about three inches. The patient had been previously treated without success, by pressure, by injection of nitrate of silver, of tincture of iodine, by artificial formation of a second opening, and the introduction of a seton. The operation consisted in introducing a double platinum wire, the extremity of which was pushed through an artificial opening. The galvanic current was then passed through the wire. The operation lasted a minute; the pain was slight. After the withdrawal of the wire, a cord could be felt under the skin about the size of the little finger. The next day the openings being closed, the crusts were removed and a teaspoonful of matter escaped. Injection with lukewarm water; no dressing. On the fourth day the openings were pretty clear and surrounded with healthy granulations. Secretion and swelling moderate. The artificial opening healed on the twenty-sixth day, the posterior one on the fourteenth. Soon after, the patient was discharged well.

III.—*Fistula in Ano*. A man, 48 years of age, was suffering from an abscess near the sphincter ani, giving rise to a fistula, an inch and a half in length and running parallel to the rectum. No internal opening could be found, and after an unsuccessful treatment by enlargement and the use of tents, the galvanic cautery was tried. An artificial opening was made into the rectum; a platinum wire passed through the fistula, and coming out of the anus formed a loop, which by its appropriate instrument having been put in connection with a battery, the whole part was divided, as in the common operation. No hemorrhage; slight pain. After two days, healthy granulations appeared, and at the end of a month the patient was discharged well.

IV.—*Erectile Tumor*. A boy, 3 months and 8 days old, had an erectile tumor situated on the left side of the face. It reached from the zygomatic arch to the mastoid process, about two and a half inches in breadth, and from the meatus auditorius to three quarters of an inch below the inferior maxilla. The tumor is raised about one inch and a half above the surface of the face. It is yielding,

fluctuating, warm, without pain, and does not pulsate; swells out during inspiration and during crying; it can be compressed and emptied like a sponge, then two small arteries are felt beating. The child is healthy and strong.

Three unsuccessful attempts were made to obliterate it by galvano-puncture. Two needles were passed into the tumor and put into communication with the positive pole of a battery. The moist skin of the tumor was touched with the negative pole. No coagulation took place, though the operation lasted fifteen minutes. The needles, on being withdrawn, were still bright. The small openings they had made were hardly cauterized. No reaction followed. Two weeks afterwards the operation was repeated. The two needles were placed at right angles, and alternately touched with the positive pole of the battery for half or three quarters of a minute. The negative pole was in contact with the skin. After fifteen minutes the needles were withdrawn; this caused some drops of blood to appear. The needles seemed, as it were, baked to the parts that surrounded them, and some force was necessary to draw them out. The tumor was a little contracted, and had become reddish. Two hardened ridges could be felt in it. No reaction occurred. Some days afterwards the tumor had again become soft and yielding. The diameters were about the same as when first measured, but it had become more prominent. Galvano-puncture was used the third time. Five needles were passed into the tumor. The operation lasted twenty minutes. After the withdrawal of the needles, the whole surface was covered with collodion. The tumor, which had become contracted during the operation, became now still smaller; its red color disappeared. For some days it remained in this state, but for a short time only. A fortnight after the operation, it was found to be larger than it had ever been before. Injections were considered unsafe in this case, and as a last resort the ligature of the carotid was proposed. This was postponed, and after six months it was resolved to try the effect of the galvanic cautery; though with little hope of succeeding. The platinum wires were passed into the tumors, crossing each other at right angles. They were allowed to remain incandescent for ten or fifteen seconds. They were then withdrawn, not without difficulty, and on account of their adherence to the cauterized tissues some hemorrhage occurred.

The tumor gradually collapsed, pulsation ceased in it, it no longer swelled during the crying of the child; and at the end of four weeks it was no larger than a walnut. A portion beneath the jaw, which had escaped cauterization, enlarged, but after an operation similar to the first, it diminished in a remarkable manner, and never again regained its former size.

Entropion, trichiasis and districhiasis have also been successfully treated by the same remedy.

V.—*Callous Stricture of the Urethra.* A patient, 50 years of age, in consequence of frequent attacks of gonorrhœa, was suffering from a callous stricture of the urethra, of about one quarter of an inch

in length, and which would only admit a bougie of one fifteenth of an inch in diameter. The urine dribbled away, drop by drop. The patient was put under the influence of chloroform. An instrument, having the curve of the male catheter, was passed up the urethra and pressed against the stricture. The connection between the instrument and the battery being formed, in ten or fifteen seconds the stricture was perforated. Four weeks after the operation the patient was discharged well. Nine months afterwards, a zinc catheter, about four lines in diameter, could be passed with perfect ease.

VI.—*Polypus of the Larynx*. A minister, 42 years old, was suffering from a polypus of the larynx, situated above the right vocal chord. The respiration was loud. It was with great difficulty the patient could speak in an audible tone. Swallowing solid food was extremely difficult. The cervical glands were swollen. On opening the mouth the free end of the tumor could just be seen behind the epiglottis. The operation consisted in seizing the polypus with a pair of forceps and throwing the loop of wire over it. By tightening the loop it slipped towards the pedicle. The galvanic cautery was passed through the wire, and the polypus drawn out by the forceps. After four days the patient left his bed, and on the fifth his room. Five weeks after the operation he had resumed his duties. One year and a half afterwards an examination proved that up to that time the cure had been permanent.

VII.—*Polypus Uteri*. A woman, suffering from polypus uteri, which had been mistaken by some nurses for a prolapsus and treated accordingly, was seized during the night with diarrhœa. The next morning a pediculated tumor, of the size of a child's head, was detected just within the orifice of the vagina. Five days afterwards, fever having set in, the state of the patient became such that the worse prognosis was formed. When the operation for removing the polypus was resorted to, she had been for several days lying in bed, pale and emaciated; she was exhausted and perspiring profusely. Between the thighs could be seen a round and elastic tumor, of a pale-red color; three quarters of which were outside of the vulva and covered with mucus. The loop of wire was passed over the tumor; on tightening it, it slipped upwards towards the fundus of the uterus; the connection with the battery being formed, the tumor was removed. No hemorrhage occurred. The cut pedicle was about the size of a quarter of a dollar. The polypus weighed one pound and nine ounces. The patient left her bed four weeks after the operation. This was owing to the state of exhaustion she was in; for in another case of removal of uterine polypus, the patient was discharged well four days after the operation.

VIII.—The last operation we wish to mention is the removal of a fibrous tumor, growing from the posterior part of the pharynx at the base of the skull. The patient, a young man of 20, had already undergone an operation for its removal. This operation consisted

in opening the nose on the right side, and cutting the tumor off with scissors. Great hemorrhage had occurred, amounting to the loss of over three pounds of blood. Six weeks afterwards the polypus returned. It was situated in the right cavity of the nose, and forced the septum very much to the left. It could also be felt by the mouth behind the palate. The right eye was slightly pushed forward. A sound could be passed to the left and to the right of the tumor into the pharynx.

Four different and unsuccessful attempts were made to surround the pedicle with the loop. During the second attempt, a part of the tumor was cut off. Notwithstanding its great vascularity, no hemorrhage occurred; no pain was felt. At the fifth attempt the loop was passed around the tumor, and it was successfully removed. It was found to weigh one ounce and one drachm. No bleeding followed; the pain was very slight, the patient complaining only of a sense of warmth in the neck and nose. The remaining root of the polypus was extirpated with scissors, not without great hemorrhage. The patient recovered slowly.

In another case a similar tumor, weighing three ounces, was removed by means of the platinum loop without the slightest hemorrhage. The patient, a boy 11 years old, was discharged after fifteen days.

For the removal of internal and external hemorrhoids, Middeldorpf's loop has proved very successful.

It is difficult to say how large an artery may be cut in this way without producing hemorrhage. We think, after the experiments we have seen and made, that any artery the size of a common quill can be cut with perfect safety; and perhaps much larger. The principal difficulty is in regulating the heat of the wire and the quickness of the hand. The wire can be too hot or too cool; in the first place it divides the tissues without singeing them, and does not prevent hemorrhage; in the second place, it adheres to the tissues which are lacerated when it is removed, equally producing bleeding. If the wire is moved too rapidly, it does not singe; if too slowly, it carbonizes the parts instead of contracting them. In both cases, hemorrhage occurs.